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Students in competence-based vocational education are expected to actively construct a personal professional theory, in which they integrate different types of knowledge and beliefs. Students' personal professional theories are seen as an important learning outcome of competence-based vocational education. However, it is unknown how personal professional theories can be measured. This study focused on measuring the content and nature of students' personal professional theories using a multi-method triangulation approach, in which 16 students in the domain of Social Work constructed a concept map, an interview and a self-report. The results show that the relatively structured methods (i.e., interviews and concept maps) reveal more insight into students' personal professional theories than less structured methods (i.e., self-reports). It is concluded that both structure as well as adequate prompts are important in the process of explicating personal professional theories.

Keywords: content and nature of personal professional theories, vocational education, multi-method triangulation

Knowledge in Vocational Education

In the landscape of a rapidly changing knowledge-based economy, vocational education prepares students for work in organisations in which employees are assumed to operate as flexible and employable professionals (Achtenhagen & Grubb, 2001; Boreham, 2002, 2004; Symes & McIntyre, 2000). In doing so, vocational schools in for example Australia, Germany and the Netherlands are currently developing competence-based curricula in which vocational core competences are used to construct competence-based qualification structures and profiles (Biemans, Nieuwenhuis, Poell, Mulder, & Wesselink, 2004; Guile, 2009). Competence-based vocational education aims to bridge economic demands and individual learning needs of students in order to stimulate the development and integration of students' knowledge, skills and attitudes (Brockman, Clarke, Mèhaut, & Winch, 2008). However, in competence-based curricula, much explicit attention is paid to the development

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of vocational skills while explicit attention to the development of knowledge is often neglected (Biemans et al., 2009; Schaap, De Bruijn, Van der Schaaf, & Kirschner, 2009; Tillema, Kessels, & Meijers, 2000). This is remarkable, since personal knowledge, which is a combination of different types of subjective knowledge, is a prerequisite for vocational competence and forms the basis for adequate performance (Billett, 2001; Eraut, 1994). Students in vocational education must internalise various types of knowledge, extracted from both school-based learning and workplace learning (Aarkrog, 2005; Lindberg, 2003). This is why explicit attention to the internalisation of knowledge in a personal knowledge base should be an important component in vocational learning trajectories (Billett, 2001).

This article conceives such a personal knowledge base as a "personal professional theory" (PPT). A "theory" refers to a set of interrelated assumptions concerning adequate professional behaviour and required knowledge, while the connectedness of components implies that change in one aspect of the theory entails changes in the theory elsewhere (Argyris & Schön, 1974, 1978). In a theory, different types of knowledge are internalised and connected in a way that directs professional actions and serves as a filter through which new knowledge is integrated and becomes internalised (Kelchtermans & Vandenberghe, 1994; Schaap et al., 2009). Eraut (1994) postulates that professionals "have their own theories about what is out there and how the world works; and these theories affect their behaviour, even if they are only partly aware of them" (p. 76).

In earlier work (Schaap et al., 2009) it is argued that PPTs are built upon a combination of declarative and procedural knowledge and are stored in the long-term memory (Anderson & Schunn, 2000; Meijer, 1999). Ideally, PPTs are hierarchically structured, which means that knowledge is stored in components that are related to each other in more-or-less complex and organised knowledge systems (Mayer, 1981). The development of PPTs is an interrelated process of socialisation and internalisation. In that process, students grow into a domain, through the internalisation of shared knowledge and collective norms, values and beliefs (Boersma, Ten Dam, Volman, & Wardekker, 2010; Wenger, 1998). Knowledge derived from participating in different contexts and situations within a certain vocational domain becomes internalised in PPTs.

There is, however, little insight in which methods reveal PPTs adequately and how to measure PPTs by using specific criteria for both the content and the nature of PPTs. PPTs, seen as a relevant learning outcome in vocational education, can be used to monitor and analyse students' knowledge development during for example school-based learning and learning at the workplace (Billett, 2001; Eraut, 1994; Hager & Gonzci, 1991). During learning in these different environments, students are confronted with various types of knowledge (Rauner, 2007) as well as with the situated nature of learning (Aarkrog, 2005; Brown, Collins, & Duguid, 1989). Research into methods that reveal the content and nature of PPTs adequately is noteworthy, because then PPTs, and the development of it, can become a central learning object in vocational education (Koopman, 2010). This means that, on the one hand, students can reflect on their PPT and accordingly they can determine whether they have enlarged their PPT or whether there are still some discrepancies in it (c.f. King & Kitchener, 2004; Mezirow, 1991). On the other hand, teachers can grasp the development of students' PPTs and accordingly, they can adapt their guiding to the actual level of the PPT (e.g., scaffolding or modelling) (c.f. Illeris, 2004; Sherin, Reiser, & Edelson, 2004).

The leading research question in this article is "To what degree are concept maps, interviews and self-reports adequate in measuring the content and nature of students' PPTs in vocational education?" These methods are selected because previous studies into personal knowledge of

professionals have shown the usefulness and validity of these methods (c.f. Meijer, Verloop, & Beijaard, 2002; Winitzky & Kauchak, 1995; Zanting, Verloop, & Vermunt, 2003).

Content and Nature of Personal Professional Theories

To generate insight in the content of PPTs, this article distinguishes six objects that make up a PPT, namely "technical-instrumental processes", "target group", "vocational domain", "organisations", "social environment" and "personal development". These objects cover a broad range of relevant knowledge and they are a powerful heuristic for revealing professional knowledge (c.f. Eraut, 1994). These objects not only cover knowledge of the primary process of a vocation, but also cover knowledge of the vocational environment and personal development, which are required for adequate performance in a certain vocation (Eraut, 2000).

The knowledge object "technical-instrumental processes" encompasses specific vocational knowledge, for example specific procedures, standardised actions or the use of specific instruments or tools (Guile & Young, 2003; Rauner, 2007). Knowledge concerning "target groups" includes knowledge that is directly used in interaction with a target group. It includes knowledge in a more standardised form, for example formalised procedures to deal with complex problems of clients. Both knowledge of technical-instrumental processes and the target group refer to knowledge required for adequate performance and effective actions (i.e., the primary process of a vocation). This knowledge is comparable to general pedagogical knowledge in teacher education and research that refers to teachers' knowledge, which they use in the primary process of teaching (e.g., in their interactions with students) (Putnam & Borko, 1997).

Knowledge about the "vocational domain" refers to knowledge of relevant developments in a specific vocational domain (Billett, 2001; Scribner, 1985). It includes knowledge of laws and regulations, domain specific developments, general cultural values, vocational ethical codes and knowledge of the environment of organisations. The object "organization" includes the structure and culture of organisations. It contains knowledge of organisational structures, councils, general work processes in organisations and cultural aspects of an organisation (Boreham, 2002; Rauner, 2007). The object "social environment" refers to knowledge of formal and informal relations inside and/or outside of an organisation, but it does not include the target group (which is a different object with different but related relevant knowledge). It encompasses knowledge of formal and informal relations and roles of colleagues or managers, power in organisations, important (social) actors in the work process and social interaction with people in organisations (Billet, 2001; Boreham, 2004). Knowledge of the vocational domain, organisation and the social environment refers all to knowledge that is required for working in a specific vocational environment, but encompasses a different aspect of that vocational environment.

Finally, the object "personal development" refers to the knowledge needed for personal development and learning, initiated in both school-based and workplace learning. It is, specifically, the knowledge of self-directed activities (Knowles, 1975), for instance of instruments like portfolios or personal development plans and how to use instruments for one's own learning and development.

Four specific qualities describe the nature of students' PPTs. According to De Jong and Ferguson-Hessler (1996), qualities can be used to generate insight into the cognitive elaborateness as well as the relevance of PPTs for the particular vocational domain (Ruiz-Primo, Schultz, Li, & Shavelson, 2001; Ruiz-Primo, Shavelson, Li, & Schultz, 2001). Both are

important for a complete analysis of the nature of PPTs. Cognitive elaborateness as well as the vocational specificity generates different information on the nature of PPTs. This article distinguishes four qualities of PPTs, namely "concreteness", "complexity", "richness" (i.e., referring to the elaborateness of a PPT) and "vocational specificity" (i.e., referring to the relevance of a PPT).

The quality "concreteness" refers to the way in which students illustrate their PPTs, for instance by using examples or explaining what they actually mean (Stoddart, Abrams, Gasper, & Canaday, 2000). This knowledge is primarily based on personal experiences and/or concrete situations to which the individual has been exposed.

The quality "complexity" refers to the way in which students elaborate and clarify their PPT (e.g., Stoddart et al., 2000). PPTs become more complex when students clarify certain knowledge or logically relate several utterances to each other (Zanting et al., 2003).

"Richness" is defined as the extent to which the students' knowledge, as explicated, is dispersed over different objects. Buitink (2007) assumes that the distribution of knowledge over different objects is an indicator of expertise development. For example, professionals with a rich PPT recognise and analyse routine situations quickly and accurately (Berliner, 1995; Billett, 2001). Eraut (1994) postulates, therefore, that for adequate performance, the knowledge base of professionals needs to be rich and needs to cover the whole domain of relevant knowledge.

"Vocational specificity" is the extent to which PPTs show specific content for a vocation. It is important to pay explicit attention to the specificity of the PPT for a vocation, indicating the process of growing into the shared knowledge and collective norms, values and beliefs in a vocational community (Aarkrog, 2005; Billet, 2001; Schaap et al., 2009). In that process, specific subject matter knowledge and norms, values and ethics have a major role in becoming a professional (Verloop, Van Driel, & Meijer, 2001). Additionally, Aarkrog (2005) and Billett have shown that specific knowledge is an important indicator for vocational expertise. It can be assumed that the nature of PPTs of experienced professionals show more specificity for a particular vocation.

Ideally, a PPT is concrete, complex, rich and specific for a vocation and covers the six defined objects extensively. This study investigated how to reveal the content (objects) and nature (qualities) of PPTs by using a multi-method triangulation approach.

Methods

The empirical part of this study included three steps, which are depicted in a flowchart as presented in Table 1.

Participants

This study was conducted in the domain of Social Work. Social Work in the Netherlands is a three-year training program at senior secondary vocational education level (ISCED[1], level IV). The goal of senior secondary vocational education is to deliver students to the labor market as well as to prepare and stimulate students to continue their educational

[1]International Standard Classification of Education, a department of UNESCO.

Table 1
Flowchart of the Different Steps in the Empirical Phase of the Study

Step	Description
1. Methods for revealing PPTs	First, to reveal PPTs in a different manner, three different but commonly used methods were selected: concept maps, interviews and self-reports. Therefore, a multi-method triangulation design was used. Second, the concept maps, interviews and self-reports were elaborated further, by applying a semi-structured approach in a different way to the methods.
2. Selecting the participants	First, a relevant vocational domain was selected (i.e., Social Work). Second, 16 students were randomly selected for the pilot study. Five of them were randomly selected for making a self-report and for an interview. Third, after the pilot study, 16 students were randomly selected for the main study. Fourth, the main characteristics of these students were investigated.
3. Collecting data (procedure)	First, the concept maps, interviews and self-reports were piloted. Second, the teachers were informed by the researchers about the procedure and aims of the study. Third, the teachers introduced the methods to the students. Fourth, each student made one concept map, one self-report and elaborated her PPT during an interview.

career in higher education (Boersma et al., 2010). The domain of Social Work is concerned with the pedagogical and social support of elderly people, young infants or disabled people.

Sixteen students in the domain of Social Work of two schools of senior secondary vocational education in the Netherlands participated in this study. The students averaged 18.5 years of age, with a range from 17 to 22 years old. All students were female, which is the case in most social oriented vocations in the Netherlands, were the population consists primarily of females (De Grip & Willems, 2003). The students were randomly selected from four classes of the two schools that each consisted of 20 students on average. Per class, one teacher participated as process instructor in the study, mainly to introduce the study to the students as well as to give students specific instructions concerning the aims and procedures per instrument. In addition, the teachers motivated the students, by pronouncing the meaning of the study for the students' personal development (e.g., they can gain insight into their own PPT).

When the research was carried out, the students were at the end of the second year of their program, in which they had already learned the basic activities of a Social Worker and in which they regularly reflected on their personal development (e.g., using a portfolio and a development plan). They all had completed a half-year internship in an organisation, which could be a hospital, a shelter for homeless people or a home for elderly people.

Methods for revealing PPTs

A multi-method triangulation design was used to gain insight in the content and nature of students' PPTs. Triangulation involves a number of different research methodologies in the study of a phenomenon to create an in-depth understanding of that phenomenon (Denzin & Lincoln, 2000; Kopinak, 1999; Meijer et al., 2002). Critical in the triangulation process is that

the differences between the methods are allowed to emerge (Miles & Huberman, 1994). Therefore, each method must be based on a different approach (Denzin & Lincoln). In this study, three methods that are often applied to elicit professionals' knowledge bases were used, namely concept maps, interviews and self-reports. Each method uses a different way to retrieve PPTs. Concept maps use visualisation and association; interviews use verbal communication as well as external interaction and self-reports use writing. First, concept maps were used to stimulate students to visualise and organise their PPT into an external representation or cognitive scheme (Kagan, 1990; Levin & He, 2008; Stoddard et al., 2000; Winitzky & Kauchak, 1995; Winitzky, Kauchak, & Kelly, 1994). Previous research has shown that concept maps were useful for identifying and developing PPTs (Huijts, De Bruijn, & Schaap, 2011).

Second, interviews were used to stimulate students in explicating and clarifying their PPTs. Previous research has shown that interviewing is a useful method for explicating personal knowledge structures, such as practical knowledge of teachers. In this way, a broad range of aspects can be tackled and in-depth information can be generated (e.g., Krause, 1986; Meijer, 1999; Zanting et al., 2003).

Third, a self-report is a written reflection task that was used to stimulate students to reflect on their PPTs and to write down their PPT (Buitink, 2007; Kelchtermans & Vanderberghe, 1994). A self-report is a semi-structured approach, in which only a few focus questions were used as stimuli to explicate students' PPTs. Simultaneously, students have the possibility to write down their PPT in a relatively unstructured and unguided way. Previous research has shown that a balance between guided and unguided task characteristics (i.e., a semi-structured approach with only some focus questions) prompts students' reflective thinking (Donaghy & Morss, 2000; Song, Grabowski, Koszalka, & Harkness, 2006). In this sense, the explication of (implicit) knowledge of professionals by a self-report is a narrative approach, which encourages students to explicate their PPTs in an authentic way (Carter, 1993).

Instrumentation

Concept maps were used in a semi-structured way (i.e., pre-determined concepts were used as first input for students), assuming that the process of making PPTs explicit is a complex cognitive activity for students and structure can help students in their thinking process (Novak, 1990, 1991). The 25 core competences of the domain of Social Work (see Appendix) were used as input for the semi-structured concept maps. The core competences represented national and European standards of vocational competence in the domain and are general in nature (Guile, 2009; Schuit, Kennis, & Hövels, 2009). These competences were used because they are standardised and abstract in nature (Achtenhagen & Grubb, 2001; Biemans et al., 2009). Therefore, it was expected that students would feel the need to clarify and specify these abstract competences and, in doing so, explicate their PPT. In the concept map, the focus question was "What knowledge is important for you as a Social Worker?" Students also had the possibility to explicate additional statements. Note here that these core competences were only used in the concept map, aiming to reduce students' mental effort during the process of constructing a concept map as well as to stimulate the explication of students' PPTs.

The interviews and self-reports were based on a different type of structuring. Interviews were used in a semi-structured way, for the possibility of asking predetermined critical or

specific questions as well as to interrogate, to summarise and to paraphrase students' answers (Kagan, 1990; Krause, 1986; Zanting et al., 2003). The interviews were structured by asking three predetermined questions, namely (1) "What is in your perspective a good Social Worker?" (2) "Which knowledge do you feel is important for a Social Worker?" and (3) "Which knowledge is, for you as a Social Worker important, specifically concerning the vocational domain and organisations?" These questions were aimed to explicate students' PPT, referring to characteristic personal knowledge for a Social Worker (Schaap et al., 2009).

Semi-structured self-reports, containing the same questions as the interviews, were used to generate a written image of the content and nature of students' PPTs.

Procedure

The semi-structured concept maps, interviews and self-reports were first piloted. In the pilot study, 16 students from one class constructed a concept map, while five students (i.e., out of the group of 16 students) were randomly selected for making a self-report. These five students were also interviewed.

In the main study, the self-reports and concept maps were completed before the interviews were administered. To avoid an order effect, half of the students began with constructing a self-report, while the other half started with constructing a concept map.

The teachers, who were informed about the procedure per method by the researcher, informed the students. These procedures included 1) an overview of the goals per method used, 2) the steps that students have to follow, and 3) some concrete examples per question. Students received a written instruction and a brief explanation first. Only a few students were familiar with constructing a concept map, because they had to make a concept map during their internship in an organization concerning the environment of that organization (e.g., related organisations or power constellations). However, this was not the case for all students, because the internships were different in nature. Therefore, all students construct a concept map concerning a general topic (e.g., the weather) to practice, to obtain familiarity with the task and ultimately to equalize students' skills concerning constructing a concept map. The instructions and the procedures for the concept maps can be found in the Appendix.

On average, students worked for 20 minutes on their self-reports. Constructing the concept maps took 30 minutes on average. The interviews lasted 45 minutes on average and were conducted by the same researcher. All interviews were audio taped with permission of the students.

Analysis

Analysing the content and concreteness, complexity and vocational specificity. To measure the content and nature of students' PPTs, as revealed by the concept maps, semi-structured interviews and self-reports, a series of steps was followed to construct a valid coding scheme (c.f. Chi, 1997). Note here that the same coding scheme (see Table 2) was used for the analysis of the concept maps, the interviews as well as the self-reports, since the methods aimed to measure the same construct (i.e., a students' PPT).

First, an initial coding scheme was developed for the content and the nature of PPTs. The initial coding scheme contained the objects "vocational domain", "organization", "social environment", "target group", "technical-instrumental processes" and "professional development". The qualities were "concreteness", "complexity" and "vocational specificity".

Table 2
Coding Scheme Concerning the Content and Nature of Students' PPTs

Object	Description of the objects	Example
Vocational domain	Utterances referring to relevant developments in a specific vocational domain, knowledge of laws and regulations, domain specific developments, general cultural values, vocational ethical codes and knowledge of the environment of organisations.	It is important that you deal with changes, for example in the law about caring and nursing.
Organisations	Utterances related to the structure and culture of organisations.	I know where I can find relevant information and I know exactly what my formal tasks are.
Social environment	Utterances referring to formal and informal relations, roles of colleagues or managers, power in organisations, important (social) actors in the work process and social interaction with people in organisations.	In my work, you have to deal with different colleagues. Therefore, communication is essential.
Target group	Knowledge directly used in interaction with the target group, it includes knowledge of formalised proceedings to deal with complex problems of clients or costumers.	When I confront patients, during an intake, with critical questions, it is important that they feel comfortable.
Technical-instrumental	Utterances related to specific, technical, standardised vocational knowledge, found in specific procedures, standardised actions or the use of specific instruments or tools.	When I have to make a medicine, I work following some predetermined steps, this procedure is important.
Personal development	Utterances referring to personal development and learning, initiated in both school-based and workplace learning.	For my personal development, I formulate personal learning goals, and I reflect on my performance. In addition, I discuss it with my supervisor.
Other utterances	Utterances that have an evaluative nature or utterances that did not refer to PPTs, including the categories evaluative utterances and irrelevant utterances.	Evaluative or irrelevant utterances like 'I don't know' or 'this is a complex question'.
Quality	**Description**	**Categories of the continuum**
Concreteness	Ranging from utterances with no concrete examples, situations or experiences to utterances with concrete examples. Illustrating utterances with concrete examples.	(1) Basic, (2) higher order and (3) concrete.
Complexity	Ranging from factual utterances, in which something is explained as true and in which only the 'what' is explained to utterances in which one or more subject-object relations or effects were mentioned, in which functions or purposes are mentioned and in which the 'what, 'how' and 'why' are mentioned.	(1) Simple, (2) compound and (3) complex.

(*Continued*.)

Table 2 (Continued.)

Object	Description of the objects	Example
Vocational specificity	Ranging from utterances that are not relevant for a specific vocation, i.e., the knowledge mentioned can be relevant for different vocations to utterances that comprise knowledge that are specific for one vocation.	(1) General, (2) common and (3) specific.
Richness	Ranging from less dispersed over the six objects (a score between 0 and 8.06) to extensively dispersed over the objects (a score above 16.14).	(1) Limited, (2) dispersed and (3) rich.

The three qualities were measured using a three-point scale aiming to generate a specific image of which method generated adequate insight in students' PPTs. Furthermore, initial decisions for segmentation were formulated. Segmentation was initiated at utterance level (Miles & Huberman, 1994). An utterance is a coding unit concerning students' descriptions, explanations, clarifications that related to one object concerning the content of a PPT. A new utterance starts as soon as a student introduces a different object (e.g., a shift from the object target group to the object personal development).

Second, the first and third author independently crosschecked the coding scheme, by coding four concept maps, one interview and one self-report derived from the pilot study. Accordingly, two minor adjustments concerning the boundaries of the objects "social environment" and "target group" and the quality "vocational specificity" were made.

Third, the final coding scheme was developed (see Table 2). Multiple examples of students' statements exemplifying each of the qualities and scale anchors in order to reduce the subjectivity of coders' judgments were included.

Fourth, the final coding scheme was checked for reliability by determining interrater agreement. Two independent raters judged 12 concept maps, four interviews and four self-reports derived from the pilot study, using the final coding scheme (see Table 2). Interrater agreement was determined for the segmentation in the self-reports and interviews and showed an adequate level of agreement (Cohen's Kappa = .77). Per method used, interrater agreement concerning both the content as well as the nature of students' PPTs was intermediate to good (Cicchetti, Lee, Fontana, & Dowds, 1978; see Table 3).

Richness was determined based on the actual data (i.e., the 16 concept maps, interviews and self-reports), referring to the degree to which a PPT is dispersed over the six objects (i.e., vocational domain, organisation, social environment, target group, technical-instrumental processes and professional development). This implies that richness depended on the actual data derived from the different methods and therefore, no interrater reliability had to be calculated.

Analysing richness. Before the actual data were analysed for their richness, only the relevant utterances were selected and related to the objects (content). Furthermore, the number of objects the respondent actually addressed was divided by six (i.e., six objects in total), which results in a number that reflects the proportion between addressed and non-addressed objects. That number was multiplied with the number of relevant utterances mentioned in each method. This results in a score on richness per method used.

Table 3
Cohen's Kappa Concerning the Content and Nature per Method

		Self-reports	Interviews	Concept maps
Content	Objects	.86	.77	.81
Nature	Concreteness	.88	.73	.67
	Complexity	.99	.91	.82
	Vocational specificity	.63	.77	.75

Richness was classified into three categories by dividing the range of scores on the six objects per method used (i.e., maximum score minus minimum score) into three equally large categories. The self-reports showed scores on richness from 0.83 to 11.33 (*M* 4.19; *SD* 2.89), the concept maps showed a range from 4.5 to 25 (*M* 18.76 and *SD* 8.47) and the interviews showed a range from 2.16 to 16.67 (*M* 8.38 and *SD* 4.27). The minimum and maximum score of the methods served as ends of the range for richness. The range was between 0.83 (the minimum score in the self-reports) and 25 (the maximum score in the concept maps). By dividing 24.17 (25 minus 0.83) by three (i.e., the number of categories for richness), the outcome, namely 8.06, was used as range per category of richness. This resulted in three categories of richness, namely (1) limited, ranging between 0–8.06, (2) dispersed, ranging between 8.07–16.14 and (3) rich, indicated by scores above 16.14 points.

Analysis of students' PPTs. For the analysis of both the content and the nature of students' PPTs, absolute scores, means, percentages and standard deviations were calculated. To determine differences between the methods used, Kruskall-Wallis tests (concerning the objects of PPTs) and one-way analysis of variance (ANOVA) (concerning the qualities of PPTs) were computed. When relevant, post-hoc analyses using Mann-Whitney U tests were administered.

Results

Content

In Table 4, the results of the content analysis of the data derived from the concept maps, self-reports and interviews are presented.

In the self-reports, the utterances are primarily related to the objects target group and technical instrumental processes. The object personal development is not mentioned in the self-reports. In the interviews, the knowledge is more equally dispersed across the objects and utterances that are more relevant were found. In the concept maps, the core competences "guiding" and "showing attention and sympathy" are mentioned by all the students (n = 16), while the core competences "collaborating and working together", "keeping up with expectations and needs of clients" and "working with high quality standards" are mentioned by nearly all students (n = 15). The core competences "commercial thinking" and "building relations and networking" are relatively less mentioned (n = 10). In the concept maps, no other utterances are given and no additional utterances are explicated.

In the concept maps and in the interviews, fewer other utterances are found, compared to the self-reports. In the self-reports, 15.33% of the utterances are coded as an "other

Table 4
Content of PPTs Revealed per Method

	Concept maps		Self-reports		Interviews	
	T	*%*	*T*	*%*	*T*	*%*
Vocational domain	12	3.77	8	4.91	9	3.92
Organisations	20	6.12	16	9.88	28	12.02
Social environment	29	8.91	11	6.75	7	3.01
Target group	164	50.31	76	46.63	134	57.51
Technical-instrumental processes	50	15.31	27	16.56	29	12.45
Personal development	51	15.60	0	0	8	3.43
Other (irrelevant) utterances	0	0	25	15.33	18	7.73
Total relevant utterances	*326*	*100*	*138*	*84.66*	*215*	*92.27*
Total	*326*	*100*	*163*	*100*	*233*	*100*

Note. Total number of utterances, based on n = 16 students (T) and Percentage of total amount of utterances (%).

utterance", while 7.73% of the utterances in the interviews cannot be related to one of the six objects. The concept maps show no other utterances.

Nature

In Table 5, means and standard deviations of the four qualities of the nature of students' PPTs are distinguished per method.

It is concluded that concept maps show information about the richness of students' PPTs, while the interviews show mainly concrete, complex and specific knowledge. Self-reports show less information concerning the nature of PPTs.

To illustrate the divergence found in and between the methods used, per method two examples are presented, that represent both a low and a high score on a particular quality. The following example, derived from an interview, illustrates a concrete and complex utterance, which is related to the object target group. The student explains:

> "It is important to know how you can coach and guide a client. In that process, you need to know the background and development of a client. A coaching process can only be effective when you know important aspects of a person. Coaching and guiding is, for me, not only offering a client some support during daily activities such as going to

Table 5
The qualities of the Nature of PPTs in each Method

	Concept map		Self-reports		Interviews	
	M	*SD*	*M*	*SD*	*M*	*SD*
Concreteness	1.01	.11	1.01	.11	1.71	.75
Complexity	1.02	.13	1.04	.19	1.51	.68
Vocational specificity	1.49	.51	1.57	.62	2.08	.82
Richness	2.31	.87	1.13	.34	1.44	.63

Note. Mean (*M*), based on 16 students and standard deviations (*SD*) *(minimum score 1, maximum score 3)*.

sleep, the background of a client is then less important, but it is more. It is mainly observing and analysing clients, giving adequate support in a particular situation and exploring problems and difficulties. For that support, you have to know the situation of the client. That is the basis of our work."

This utterance shows concrete knowledge concerning the support of a client, while it shows at the same time what a Social Worker needs to know and how a Social Worker can perform adequately according to the student. This utterance is coded as highly specific for Social Workers, because it is embedded in the specific vocational domain and it represents also some common norms and values of the specific community (e.g., referring to the basis of "our" work).

Another example derived from an interview focuses on the object organisation and is coded as basic (concreteness) and compound (complexity): "I know the policy and strategy of the organisation that I work for. What are their norms and values? I think that is important, because you can explain your support to for example parents and other related organisations". This utterance was coded as compound, because it is explicitly mentioned what the effects of certain actions are, an "if-then strategy", but is not complex because mainly the "how" (in this case how norms and values can be used to explain support as well as how to actually explain and clarify certain actions to the target group) remains implicit. The utterance is scored as basic, because neither concrete examples nor illustrations to obtain more clarification were mentioned.

Self-reports show less concrete, complex and vocational specific knowledge. The following example, derived from a students' self-report, shows a relatively less concrete and complex utterance. However, within the self-reports, this utterance is one of the most elaborated ones; the most utterances were even less concrete or complex. The student states: "You need to know the most important features of the target group, because only then can one estimate the situation in the beginning of a certain trajectory." This student did not explicate the "how" and "why" of the knowledge; she only states that knowledge of the target group is important and when that knowledge is required. Therefore, this utterance is coded as basic (concreteness) and simple (complexity). Another example from a self-report, which is also coded as basic and simple, is "I know the protocols and policies of the organisation". This utterance relates to the object organisation and is coded as less specific for a specific vocation, while it can also be true for other vocations.

Finally, in Figures 1 and 2, examples of two concept maps are shown. The first figure shows an extensive (rich) concept map, while in the second figure a less elaborated concept map.

The concept map in Figure 1 scores 25 on richness, while the concept map in Figure 2 scores eight points on richness. This is foremost since the student of the first concept map explains several relations between concepts, relate concepts more explicitly and uses more concepts to represent her PPT.

Comparing the Methods

Analysis of variance using Kruskal-Wallis test shows significant differences between the three methods used concerning the total number of utterances containing relevant content: χ^2 $(2, N = 395) = 12.80, p < .01$. Post-hoc analyses using Mann-Whitney U tests (with Bonferroni's alpha adjustment) show that interviews and self-reports differ significantly: $Z = -2.61$,

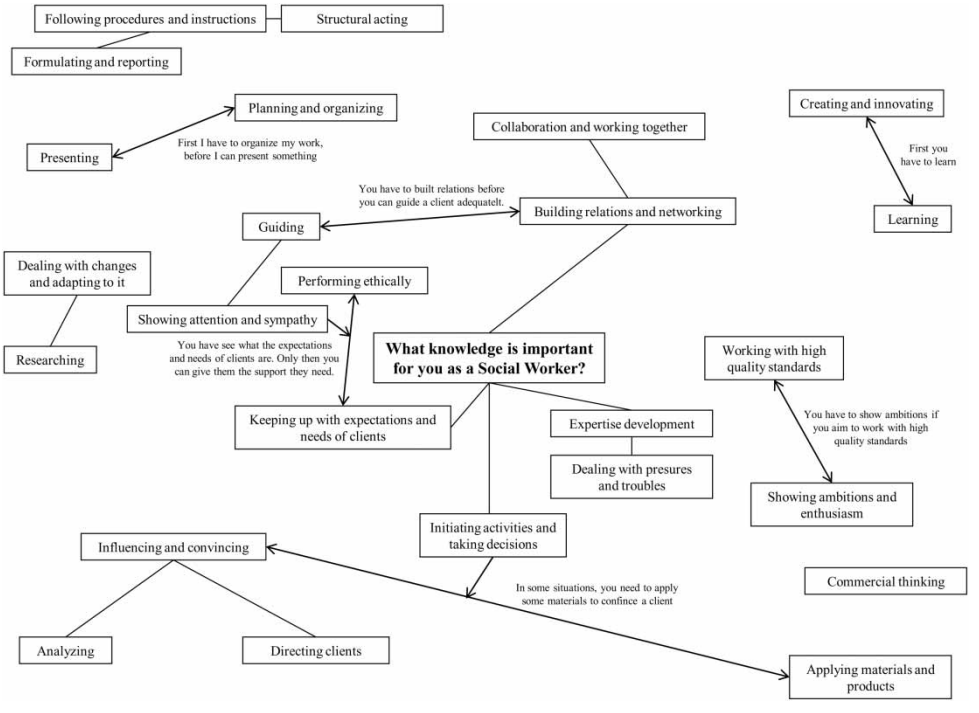

Figure 1. An example of a student's concept map that obtained a high score on richness (i.e., rich).

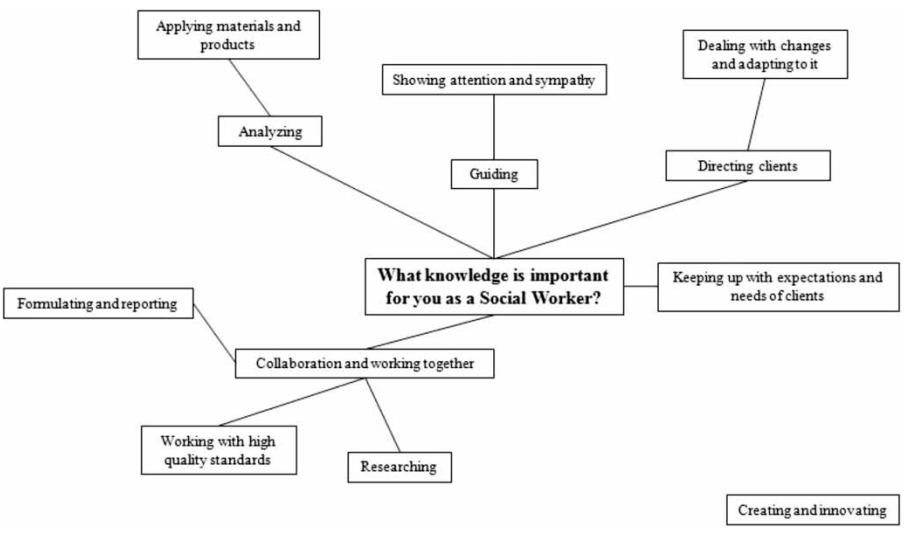

Figure 2. An example of a student's concept map that obtained a low score on richness (i.e., limited).

Table 6
Differences between the Qualities per Method

	One-way ANOVA			Post-hoc (Mann-Whitney)		
Quality	F (df)	p	Methods	M	SD	p
Concreteness	206.36 (2, 711)	< .01	Interviews, self-reports	.68	.04	< .01
			Interviews, concept maps	.71	.04	< .01
			Self-reports, concept maps	.02	.04	.99
Complexity	107.61 (2, 711)	< .01	Interviews, self-reports	.46	.04	< .01
			Interviews, concept maps	.49	.03	< .01
			Self-reports, concept maps	.03	.04	.99
Richness	30.05 (2, 45)	< .01	Interviews, self-reports	3.56	2.01	2.47
			Interviews, concept maps	−11.32	2.01	< .01
			Self-reports, concept maps	−14.89	2.01	< .01
Vocational specificity	57.40 (2, 711)	< .01	Interviews, self-reports	.51	.07	< .01
			Interviews, concept maps	.58	.06	< .01
			Self-reports, concept maps	.07	.06	.71

$p < .01$. In addition, concept maps and self-reports differ significantly: $Z = -3.63$, $p < .01$. Interviews and concept maps show no statistically significant differences concerning the total number of content related utterances: $Z = -1.56$, $p = .12$. This shows that interviews and concept maps show more knowledge than self-reports.

Analysis of variance using One-way ANOVA shows statistically significant differences between methods concerning the four qualities (Table 6).

The results show that interviews reveal more concrete, complex, specific knowledge, but that concept maps give more insight in the richness of PPTs than the interviews and self-reports do. Self-reports appeared to show less insight in students' PPTs.

Conclusion and Discussion

This study found differences between concept maps, interviews and self-reports when measuring the content and nature of students' PPTs. Interviews elicit more affective information, while concept maps and self-reports show more abstract information. In addition, interviews show more concrete and complex knowledge than the self-reports and concept maps do. Concept maps show more information in a quantitative way (i.e., richness), while interviews show more in-depth information. Self-reports seem to be a less adequate method for explicating PPTs, because it generates both simple, basic and general utterances as well as relative large number of other utterances.

Concept maps stimulate the explication of knowledge, although this knowledge is mainly basic, simple and general in nature. On the other hand, in the concept maps the knowledge is extensively spread across the objects showing the richness of the knowledge. Though, the utterances in the concept maps referred mainly to the objects "target group" and "technical instrumental processes" (i.e., the primary process of a vocation). It was expected that offering students predetermined input (i.e., the core competences of a particular domain) would stimulate a further explication of knowledge. However, this predetermined input in the concept maps resulted in relatively high scores on richness only, while the concept maps show

relatively low scores on concreteness and complexity (e.g., the depth of the PPT). The core competences did not seem to stimulate students to elaborate more on their PPTs (i.e., concreteness and complexity). A more open variant of concept maps (c.f. Winitzky et al., 1994) can be used, in order to stimulate students more to clarify and illustrate their PPTs, but a common disadvantage of an open approach is that idiosyncratic and abstract data can occur (Meijer, 1999). Nevertheless, the results indicate that more abstract core competences of a vocation can be used as stimuli for retrieving PPTs, but that additional stimuli are needed in order to explicate PPTs adequately.

One explanation for the differences between the methods is that most students are not able to explicate their PPT without any structure and scaffolds. This study showed that the relatively structured methods (i.e., interviews and concept maps) show more insight in students' PPTs than less structured methods (i.e., self-reports). Offering students specific questions, short summaries or paraphrases (i.e., in the interviews) will help them explore and explicate their PPTs. In the self-reports, for example, only three prompts were used, while in the interviews, more structure and/or scaffolds are likely to occur (Sherin et al., 2004). It is also possible that students, in the interviews, felt the need to clarify their answers since they were in interaction with an interviewer and that they did not have to rely only on their own thoughts (Kagan, 1992). This external interaction is lacking in the self-reports and concept maps.

The present study was subject to some limitations. First, it can be questioned whether the questions used in the different methods are adequate for explicating PPTs, for example a question like "What is for you a good professional?". It is noteworthy that self-reports show a relatively large number of irrelevant utterances, which can be caused by using these prompts. It is therefore important to pay explicit attention to the prompts or stimuli needed for an effective use of the methods, since the prompts determine largely the outcomes per method (Meijer et al., 2002). Second, although this study did not aimed to generate results that are representative for a certain vocational domain, it is noteworthy to keep in mind that results and conclusions must be interpreted as tentative, mainly because of the small sample size and because of the domain-specific results.

Further research to the content and nature of PPTs is therefore needed. For example, using a more extensive sample size, in which students from different vocations and different phases of vocational learning, might generate further insight in the actual content and nature of students' PPTs. Additionally, a longitudinal design might be used to detect specific developments in the process of growing into a specific vocation. Such a design demands a combination of different instruments, as each instrument has its own way in eliciting students' PPTs (Kagan, 1990; Zanting, Verloop, & Vermunt, 2001; Zanting et al., 2003). It is then interesting to see whether students' PPTs change over type, during for example combining workplace learning activities with school-based learning (Aarkrog, 2005). Subsequently, two strategies for explicating students' PPTs can be formulated, based on the results of this study. First, a combination of different methods (i.e., concept maps and interviews) seems to be adequate for explicating PPTs, because each method stimulates the process of explication in a different way and therefore, different methods can reinforce that process. Second, a specific method can be used, i.e., concept maps, in which different prompts or stimuli are pointed to specific objects of students' PPTs. We expect that a certain strategy (i.e., more specific stimuli) generates more specific and deeper insight in students' PPTs. Then, more open-ended concept maps (again, pointed to different objects which offers students structure), seem to be more adequate, as students are not restricted to some predetermined concepts (Novak, 1990).

During specific learning situations, such as working in authentic contexts on specific tasks or during collaborative problem solving, explication of PPTs and reflection on it are important, since they have a major role during actions and performance (Argyris & Schön, 1978; Eraut, 2000). As this study has shown that both structure and adequate prompts are important in the process of explicating PPTs, we recommend that teachers in vocational schools or trainers at the workplace stimulate and scaffold that process. Teachers and trainers can make students aware of the role of their PPT during their performance (Schaap et al., 2009) as well as in learning new skills (Guile & Young, 2003). Ideally, also teachers and trainers explicate their PPT in a way students can learn from it (see Zanting et al., 2001), as is the case in modeling as a teaching strategy (c.f. Collins, Brown, & Newman, 1989). In this way, a community of practice can arise in which different types of knowledge are combined and in which new knowledge is constructed (Wenger, 1998). This might be a promising way of addressing personal knowledge development (by means of internalization and socialization) as an important and relevant learning outcome in competence-based vocational education.

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Appendix: Instructions of the concept map assignment including core competences of a Social Worker (Schuit, Kennis, & Hövels, 2009)

Instructions	Core competences of a social worker
1. Please construct a concept map for what you think is important for a Social Worker (i.e., knowledge). The goal is to gain insight into the concepts you think are important and how these concepts are related to each other. Include any terms that make sense to you and that are relevant to you. What is important is that the map you construct reflects your thinking about the most important knowledge of a Social Worker (in the assignment, an example was included of a concept map concerning a general subject, such as the weather or football). 2. In the first place, look critically to the core competences of a Social Worker. You are not restricted to use all core competences: you can use them all, but you can also select some of these core competences. 3. If necessary, write down as many concepts or small sentences when you think they are important in your vocation (i.e., generate own concepts); please make sure that it is to someone else clear what you mean with a concept or a clarification. 4. Place related concepts closer to each other than the concepts that are not related. 5. Place the concepts in your map, where the concepts in the centre are most important to you. 6. Relate the concepts used to each other and clarify the relations. 7. Finally, look critically to your map: does it represent your thoughts adequately?	■ Expertise development ■ Commercial thinking ■ Collaborating and working together ■ Building relations and networking ■ Formulating and reporting ■ Structural acting ■ Applying materials and products ■ Planning and organising ■ Following procedures and instructions ■ Initiating activities and taking decisions ■ Directing clients ■ Guiding ■ Showing attention and sympathy ■ Influencing and convincing ■ Dealing with changes and adapting to it ■ Presenting ■ Analysing ■ Researching ■ Keeping up with expectations and needs of clients ■ Working with high quality standards ■ Performing ethically ■ Learning ■ Creating and innovating ■ Dealing with pressure and troubles ■ Showing ambitions and enthusiasm